Marine Construction & Welding

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Module No. 01
Lecture No. # 04
Basic Structural Components

Today, we will talk about the basic structural components. In the last class, we have dealt with the structural requirement, that means, what all the strength requirements of structure to fulfill the desired service which one expects from the product.

So, there we saw that one will have to look into the aspects of longitudinal strength, transverse strength, torsional strength, and local strength. To provide that, we also talked about framing system, how we go about stiffening them, how do we go about providing that strength. We introduced the concept of longitudinal framing system, transverse framing system.

So, that framing system essentially talk about, we deal with stiffened panels, that means, plates with stiffeners because for the individual plate, if you want to provide for the necessary strength, we have to go on increasing the thickness of the plate.

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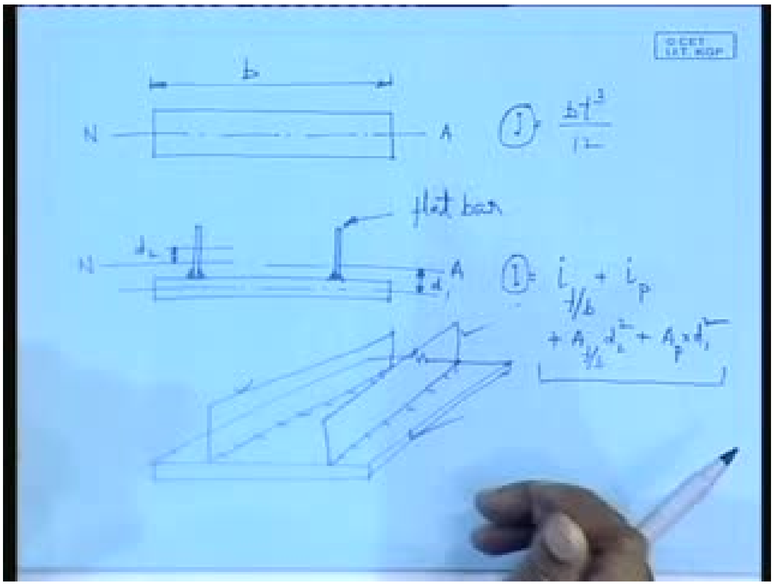

Then what happens we may achieve the desired strength, but at the same time we increase the weight very heavily, so, that other requirement of strength weight ratio gets jeopardized. So, best thing is to go about for providing stiffness, we can once again take a look at that. In case of a plate, how do we judge what is the stiffness of this plate? This is a cross section of a plate. So, naturally you will have the neutral access of the plate through its mid plane. So, stiffness is a function of your moment of inertia, so here the moment of inertia is - if t is the thickness and b is the breadth of the plate, then the moment of inertia becomes, how much it is, b t cube by 12; so, to increase thickness, you will have to go on increase the moment of inertia. Instead, I take marks thinner plate and provide some stiffener here; by providing stiffener means - suppose, these two small flat bars I am welding to this plate.

This is a flat bar, a flat piece of plate in some thickness, whatever be it. What is this i of this particular section? i of this section would be, if I calculate i about its own mid axis, i about its own mid axis and then both the i is transferred to the equivalent neutral access of the entire system; now, the neutral access shifted from the mid plane of the plate. This is the shift of the neutral access taking place, so we benefit by this component, also this component, say this is my d - say d 1, this is d 2. How do we benefit? Because whatever the own moment of inertia we are getting of the flat bar plus we are getting of the plate plus because of the shift in the neutral access, that is actually area of the flat bars into the d 2 square - this additional terms; also we get the area of this plate - cross-sectional area into d1 square; so, here these are the two additional components we are getting. That means when we weld the two flat bars, if we see in a schematic, in an isometric form, it is essentially like this.

This is a plate and here you have this, this one is welded; similarly, another one. I have drawn two of them - two pates welded to the best plate; these are acting as stiffener stiffening the system, so this can be referred to as a stiffen panel.

If we compare this momentum of inertia, what we are getting here and that of this, we will see. The moment of inertia in the second case is much higher compared to the first one. If you want to match it to the first one, then what we will find - the weight of this and weight of this system, there will be a gross difference.

The second one will have a much higher strength to weight ratio, that means weight will be much less for the same stiffness, so that is how thing is. We go about using stiffen panels which will provide us necessary strength. Now, depending on the orientation of the stiffeners: primary stiffener, secondary stiffener, etcetera, we will say either it is a longitudinally stiffened system or a transversely stiffened system.

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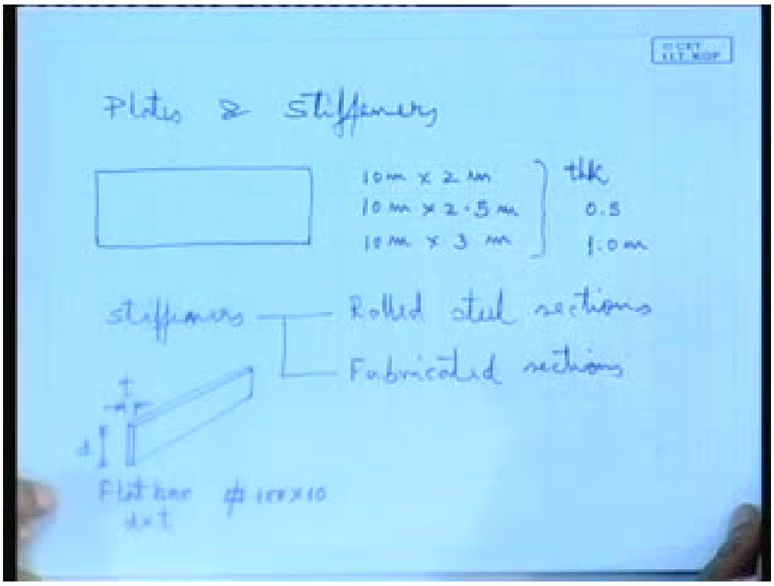

Because we have seen, to provide for longitudinal strength, transverse strength, and so on - we will make use of combination of both longitudinal framing system as well as transverse framing system.

Now, to provide for this strengthening what we need - certain basic structural components; so, what are those basic structural components? They are those, basically, plates and stiffeners; basic structural components are nothing but plates and stiffeners. What are those stiffeners, plates? Plates are standard, I mean in ship building practice, generally there is plates, which are used as they come from the steel mill. They are of standard rectangular sizes, the sizes which are available generally are: 10 meter long by 2 meter wide - 10 by 2 or we get 10 by 2.5 or we have option for 10 by 3 meter, generally, these are the three standard sizes we get; so, when you are designing a ship or any such thing, we will have to do the plate estimate - how much plate is needed?

So, eventually you will convert it to number of such sizes, so these are the overall size. Obviously, we will have to tell the thickness also; thicknesses are available, thickness in short is generally referred to as t h k.

Thicknesses are available generally, at an interval of 0.5 millimeter to a certain thickness and then at an interval of 1 millimeter; that means, plates will be available at 4 millimeter, 4 point 5, 5, 5 point 5, 6, 6 point 5, and so on, and then possibly after say, I think it may be after, 12 or 14 then it is 15, 16, 17 and so on and then again when you exceed 35 it is 35, 40, 50, 60, 65 like that. So, at certain interval of thicknesses you have a wide choice, so you can accordingly design your thing.

That satisfies the strength requirement, and definitely look into the aspect of not over strengthening it, that means - provide for the necessary thickness of the plate; so, that is one side as far as the plates are concerned.

Next are the stiffeners, because you will have to use. You have just seen how the stiffeners play a role. The stiffeners essentially can be classified as two types, one is - they are referred to as rolled steel sections - here we are talking primarily of steel construction, same thing is to some extent true for aluminum construction also; we have primarily of steel, so one type of stiffeners are referred to as rolled steel sections, another can be referred as fabricated sections.

What are these rolled steel sections? They are flat bars; this flat bar is nothing but. So, it will be designated by some d into t - d is the depth and t is the thickness; so, it is designated by d into t.

Generally, it is written like this. (Refer Slide Time: 12:00)

This symbol implies that it is a flat bar and 100 into 10 means - 100 is the depth and 10 is the thickness, and length - it comes in a standard length, generally 20 meter, so length is not the direct criteria. Criteria is depth and thickness because length will have to ultimately the length of, say, the deck of a ship you are strengthening it (( )) putting stiffeners, so actually you will not only put whatever the length of one stiffener is available, you will go on adding it.

If the length of the deck is 100 meter, you will have a 100 meters continuous stiffener; I mean, all the stiffeners will be 100 meter long, but you do not get 100 meter, you will get in pieces. Same thing, the deck is 100 meter long, you do not get 100 meter plate, you will get 10 meter long plate; so, as if we will put 10 plates and weld them together; so, in any case rolled steel sections, so the first one is referred to as flat bar.

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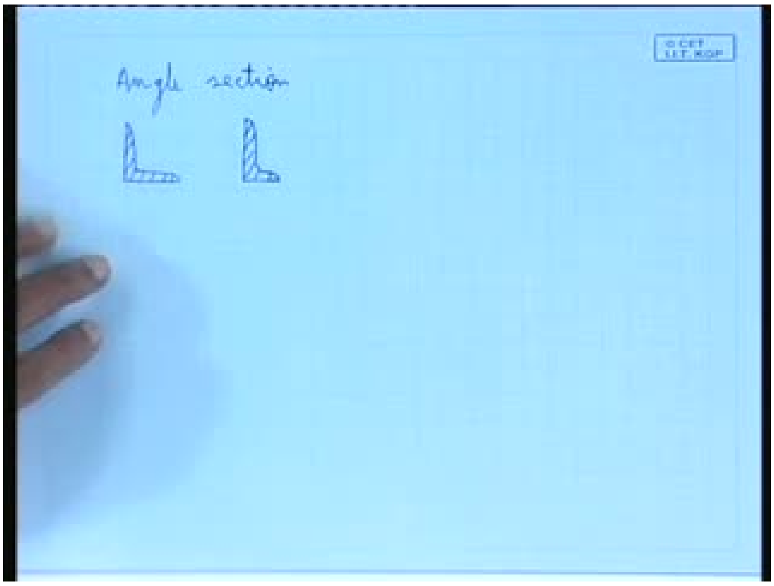

Another rolled steel section is angle section, they look like this or; that means, this is unequal angle, this is equal angle, that is all.

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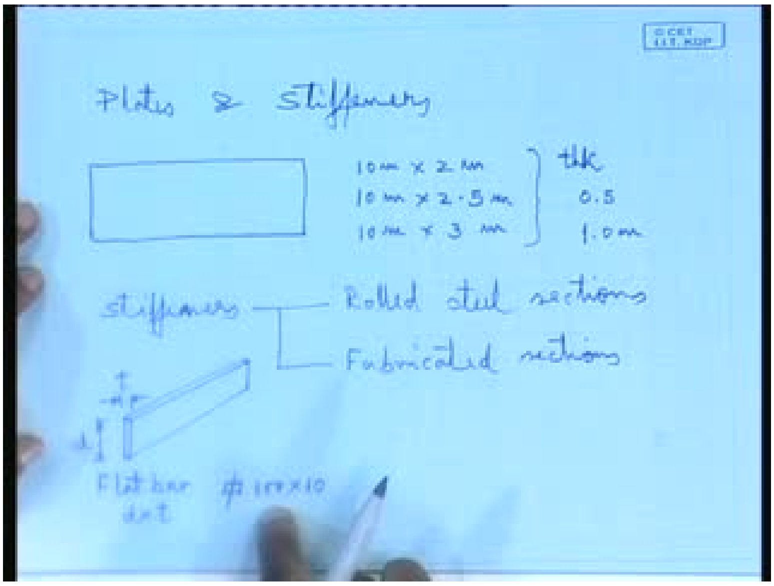

In this case, we only talked about flat bar; flat bar means it is a piece of plate having certain depth, this depth - just assume - if this depth becomes 2 meter, then it becomes a plate.

So, obviously you will not have a flat bar of 2 meter depth, then this is no more a bar, it is a plate. So, here what we want to say is - this bars are not cut from this plates, they are rolled like that, that is why, they are referred to as rolled steel sections - like steel plates, they are rolled. How they are manufactured, do you have any idea?

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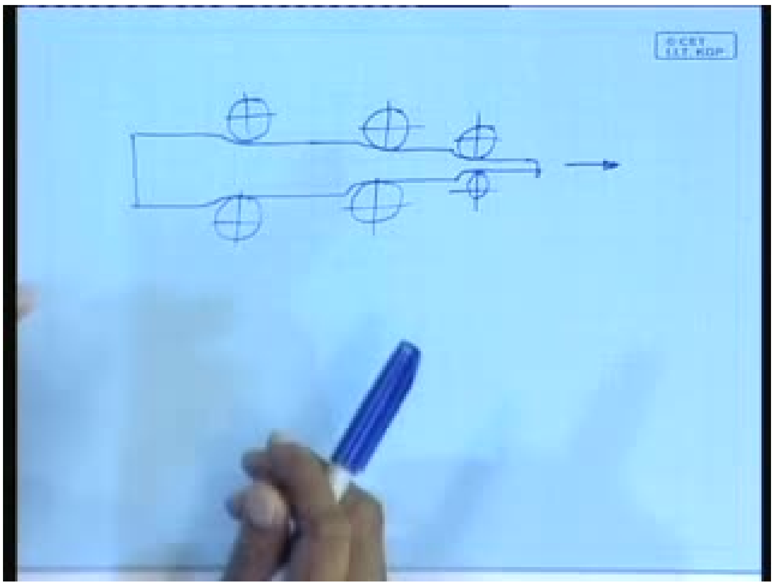

This steel plates, if we start from the zeroth level, that means you take the iron ore and extract iron, then convert it to steel, then what do you get - we get steel ingots; ingots means quite big chunks of steel. So, those ingots are passed through rollers, several multiple rollers, which are generally referred to as rolling mill; you pass through the rollers and they are gradually rolled down to the required thickness. Just draw schematically; it would look something like this.

This is a multi-stretch rolling, as you can see, gradually the thickness is going down; a thick ingot is passed through a set of rollers gradually, which is pressing it down. This rolling is done hot rolling, it is at an elevated temperature; when the ingot is cast and having an elevated temperature of around 800 plus degree centigrade, this is passed through the rollers, so it will gradually squeeze it down and bring it to the desired level. The final set of rollers will be set - if you are producing a 20 millimeter thick steel plates, so they will be set accordingly - such that at the end you are getting 20 millimeter thickness.

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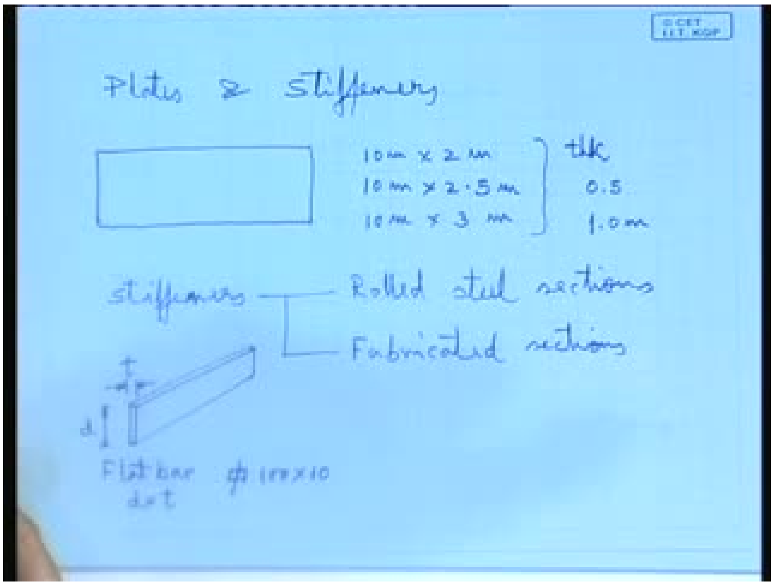

In any case, similarly, this flat bars also will be rolled of different depths, this different depth will vary from, say, it can be small flat bars of 20 - 25 millimeter depth to big flat bars of 300 millimeter depth, generally you do not go more. There are certain standard sizes - it is not that you think that ok let me make 172.5 millimeter depth flat bar, no, it is not that way; there are certain standards set and those standards are globally accepted.

There are Indian standards, there are Japanese standards, there are French standards, German standard, British standard, but generally close by similar, because you design a structure, the final design is, you have to match it with what is available in the market. It cannot design, say, a take I am designing and the optimum design says that it should have a plate thickness of 16.35 millimeter thickness and stiffness of some dimensions of 285.32; it does not make sense because 285.32 - you will not get anywhere, neither you will get 16.25, no. You will get either 16 point 5 or may be, from 16 you will get straight 17, but your optimum design calculation says that it is 16 point say three five or three four whatever, it does not make sense. You will have to go for 17 millimeter thick plate because that is available; this you cannot get it, in the sense, make to order rolling is not done, you cannot do that. So, there are standards; flat bar - it can be standard millimeter depth of different thicknesses, so that is what is flat bar.

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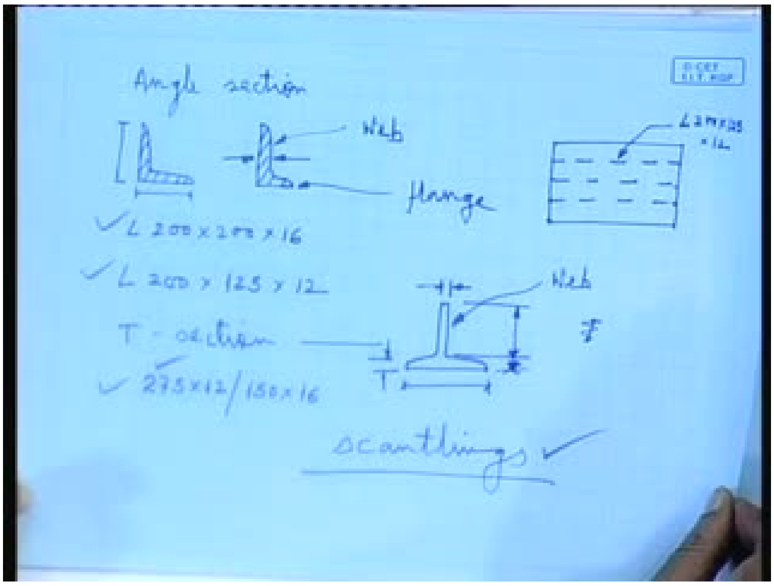

Then, we have been talking about angle sections - that is the next set of this rolled steel sections. These are designated like this - 200 by 200 by 16, means this is 200, this is 200 and 16 is the thickness. You can see, at the edge it is thinning down, so not that thickness, the average thickness in both these arms; these arms are referred to as - generally the longer arm is referred to as web and the shorter arm is referred to as flange. In an equal section both are same, unequal section can be like this - 200 by 125 by 12, it will be written like this.

Wherever you make a drawing, suppose you have made a drawing of a flat stiffened plate, and in the drawing in the plan view, you will show like this as if the plates are having three stiffeners; so, it is enough if I write this like this. If I write like this, that implies, that the dotted line indicates there is an angle section of 200 by 125 by 12 welded. So, that is what is called rolled steel section, one of the rolled steel sections' angle section, and 12 or 16 they are the thickness, this is thickness. (Refer Slide Time: 20:00)

Next rolled steel sections which are used are T section. As the name, you can see, like this, t section. Here, this is my depth; actually this depth is used, so here is the thickness and you have another thickness here. Till now all thicknesses were same, here in this case, you can have different thickness - a thickness for the web and a thickness for the flange; so here this one is the web, this is designated as, 275 by 12 slash 150 by 16. What does that mean? That means, the web is of depth 275, thickness 12 millimeter, and the flange's breadth is 150 millimeter, thickness 16 millimeter. If we change these figures, the moment of inertia changes, so from where we are getting all these? These are of course a different issue - that we will be getting from certain type of calculations, which will tell us what should be the dimensions of these stiffeners which will provide us with that required section modulus? The section modulus is the measure of the stiffness of the structure - rigidity of the structure or strength of the structure.

These are all referred to as scantlings, as I was telling sometime back, scantlings. This term is used like, the stiffness scantlings are 275 by 12 150 by 16 T section, 200 by 200 by 16 angle section. Scantlings is a term, a nomenclature that refers to the dimension.

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Generally the web first and flange next. What happens is, by convention, the web is having a higher depth compared to the breadth of the flange.

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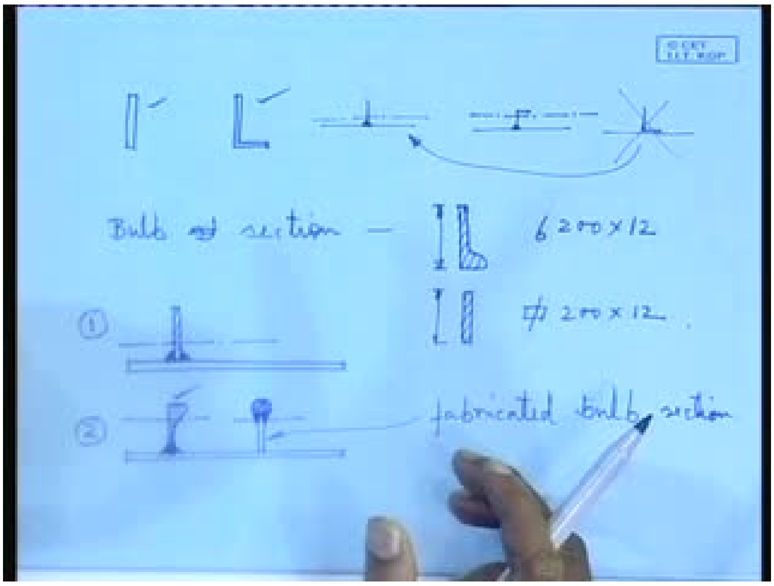

What is the contribution of this flange and I mean, why this concept of web and flange? What is the difference between a stiffener which is flat bar and a stiffener which is an angle section?

We will come to this question again. Another rolled steel section is referred to as bulb section; bulb section - what is this? It is somewhat like this, a section of it looks something like this - that means, as if there is a bulb attached at the end. How do we designate it? We designate it like this. (Refer Slide Time: 26:16)

There is a difference, I have drawn something - so it refers as a bulb section because if I do not do this then 200 by 12 can be a flat bar, can be a bulb, so just to distinguish this is that. So, tell me, what is the great difference between this and this? That will take us back to what we started.

I drew one flat bar, an angle, we talked about the bulb section - they are somewhat similar, all the thing. A bulb section is that as if at the end of the flat bar I have put a bulb. Now, I have one bulb section wherein this 200 means this is 200, flat bar 200 means this is 200, and both are of same thickness, so what is the great difference between these two?

I am coming to the next thing, suppose you assume a plate which is being stiffened. This is a plate cross-section, the length is going like this, so herein I want to stiffen it.

Stiffening means what? Means, if this is a stiffener - flat bar, I am welding to the plate - both sides, that is what we are doing. So, this flat bar, I am putting it here, showing the flat bar by one single line because when we will be making the drawings, we will not show double lines for the simple reason - when you draw in scale, this double line cannot be shown because this breadth can be 10 meters and thickness is 10 millimeter, it is impossible to show, is not it? So, customarily we show by single line, but now for sake of just explaining, we are showing in double lines.

Another case, where if the same plate and I am using the flat bar. Now, tell me, you see how I put the flat bar, not the flat bar, the bulb section and this is welded here; similarly, this also welded here. Is that, will these two structures have different strength stiffness or they will be identical, I am putting of the same dimension, obviously?

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Because since the stiffeners are different, has to be different. Now, which one will be stronger?

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The bulb one. Why?

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Tell me, I mean you are coming to the correct point definitely, but tell me before, putting this bulb like this is easier or.

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It shifts the neutral access more further, so that is the purpose of flange basically, we will come to this; again let us come back to this angle section and the flat bar. Say, a case of a plate and I am just putting a flat bar, so I have shifted the neutral access somewhere here. Let us assume the same thing - a plate and an angle section, see I have put the flange above, in this way fixing it, welding it is very difficult because you put the angle section, it will fall, is not it? But the other way, if I would have put from fabrication point of view, it would have been easier, but this is nothing but a case of flat bar basically, because this flange then is not contributing much. What do we need? We need that particular component, that a d square component - the distance between the two neutral axis.

So, this is not done, this is not practice. Instead it is like this, though putting it is difficult - that means, you will have to have mechanism to hold the angle section in that from, it is an unstable condition, is not it? We have to hold it, weld it, once it is welded, it is fine, it remains; the flat bar also. So, what would be the difference in this case? (Refer Slide Time: 31:30)

Your shift on neutral axis will be much larger. Here it was d, here it was a multiple of d - may be 2 d or whatever, more - so that is the thing of this flange; so that is how the flange works. That is what is happening here also, the bulb section - you put it like this; this bulb is equivalent to that of, as if, I have the flat bar and a rod - a circular thing, if I weld it also does the same trick, because my purpose was - here the neutral axis was shifted to this much, here the neutral axis was shifted sufficiently, same here also, but here what I am doing, I am fabricating it. We have talked about fabricated sections, so this can be referred to as a fabricated bulb section.

The second one, it is a fabricated bulb section, means, it is not truly the bulb section what we get in the rolled steel category. This bulb sections, angle sections, flat bars, steel bars, all those are - you get it standard rolled steel sections, they are rolled from the steel mill, you have standard sizes, various sizes though, but standard.

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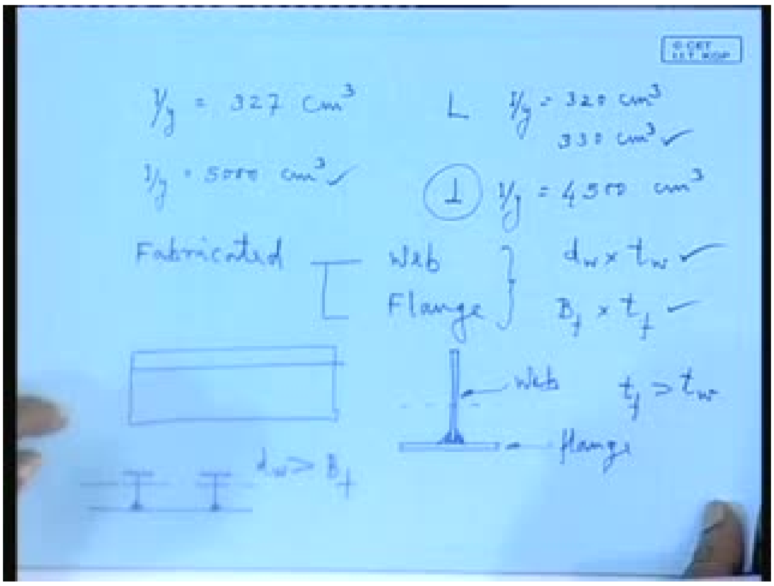

Supposing, you have a very nonstandard requirement wherein you need a certain particular section modulus which is not fitting very much in your available sections. What you do if it is not fitting? We look for the next higher, what does that mean? That means, suppose my calculations show that you need a section modulus; the section modulus requirement for a certain stiffener is 327 centimeter cube, calculations say like this. You look in the standard tables, standard charts which are available from different manufactures, so there I find that there is an angle section available whose section modulus is 320 centimeter cube, then the next one is available which is 330, but my requirement was 327, so I will choose this one.

Now, suppose a situation wherein I need a section modulus of 5000 and I check in the tables, I do not find; definitely it will not be available in the flat bar, also not in bulb section, also not in angle, probably in t sections because t will be more - because we have more material there, is not it - a full web and a full flange.

But there also let us say, the maximum t we are getting is 4500 and we are not getting beyond that, then what to do? Will have to have a fabricated stiffener or fabricated sections. What are those fabricated sections? Basically, what we will do, we will find out the dimensions of the web and the dimensions of the flange. Now, obviously, you will have, many combinations are possible; this web will be - your depth of web into thickness of web, breadth of flange into thickness of flange - so, many combinations of these two will give you the required section modulus actually. You will have to choose the one which suites you best because you can have very deep web and a small flange, or a shorter web, thicker web and wider flange because i by y is a function of geometry, section modulus is nothing but essentially function of geometry; so go on changing geometry, different combination of geometry of both web and flange will give you the same value 5000 or whatever you are looking for; you will have to then see which one suites you best.

What is done essentially is, you will have to cut this necessary depth to thickness and breadth thickness - these two from standard plates.

You cut out the flange, this thickness, and this t f may be different, so from another plate you cut out the web, put them together and weld it. This is your fabricated t section, so weld it and you get the fabricated t section.

So, generally, the bigger component is web and the shorter or narrower is the flange, and generally your thickness of flange is greater than thickness of web. That is generally so for the simple reason, why? Why not the other way? Why not the thickness of web is more than the thickness of flange? By making thickness of flange more, I shift, push the neutral axis further; further if I can push, I gain more in terms of that a d square component. So, thereby for the same weight, I have more moment of inertia - so it becomes a better design, I get more strength, stiffness.

For the same reason again, the depth of this web, d w, is generally greater than breadth of the flange because more the depth, more your neutral axis is going away, and always, these are welded. So, this is my plate - if a t section is welded, it will be welded like this. It will be welded here obviously, because then I have my neutral axis of the system, stiffened panel, away from the plate, much away, so we have more stiffness.

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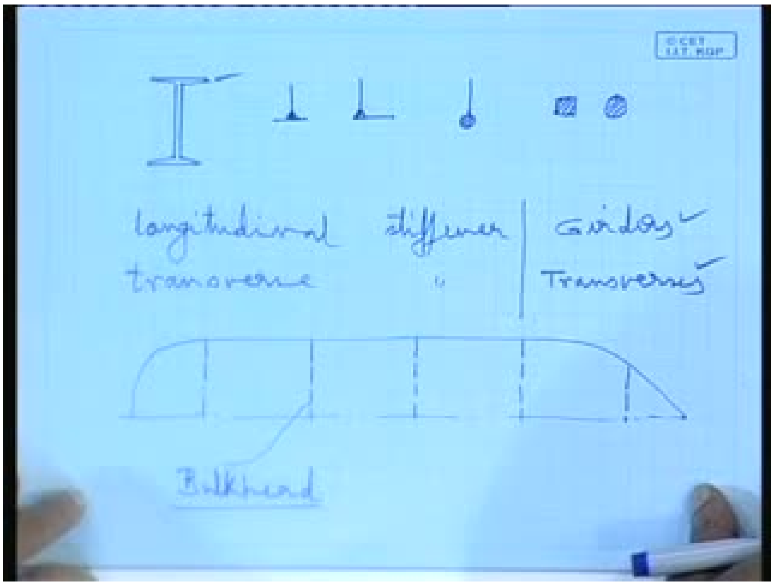

So, that is the basic, there are many more rolled steel sections, but these are the four types which are mostly used in ship building, so I am not going for i sections, h sections. There are different sections also, like i which is nothing but somewhat like this, these are not much used, so I am not going for that. Because what happens, if I use this i section there, one side of the flange becomes useless; at best this i section can be used as pillar where you need a pillar, so probably, i section or somebody refers to it as h section can be used as a pillar. Otherwise, for stiffening purpose those are the four rolled steel sections which can be used or the fabricated sections. Fabricated section can be a t section, can also be an angle section; when it is an angle section, it is like this, when it is a t section, it is like this or if it is a fabricated bulb section, like this. We just weld a round bar, this is referred to as a round bar; you have square bar, you have round bar.

So, that is what are the basic structural components or the basic building blocks of the subsequent structures which will be used in to develop the entire ship or the offshore platform even.

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There, all is at ninety degree; same thing, t section, all is at ninety degree.

So, these are all the basically rolled steel section or fabricated sections which constitute your longitudinal stiffener or transverse stiffener; they will be either referred to as longitudinal stiffener or transverse stiffener. Now, there are other terms used which are referred to as girders; girder also transverses.

Girders are nothing but longitudinal stiffener of heavier scantling, they are referred to as girder; they are also longitudinal stiffener, but bigger scantling, say, when my stiffener is 100 by 12 or 200 into 125 into 13 - so, longitudinal stiffener. But why it is becoming 500 by 400, so on and so forth - that much of bigger scantling is referred to as girder; same thing - a transverse stiffener, why it is of bigger scantling? We simply call it transverse.

Now, when this girders and transverses or this longitudinal stiffener or transverse stiffener, used in different location, it assume different names. For example, if I look into a deck - deck of a ship - you have already done lines plan so it is somewhat like this - I am drawing only the half of the deck, and let us assume that these dotted lines I am drawing - you have heard about something called bulkheads? No; for the time being let me just mention that they are also some of the structural component, which are referred to as bulkhead; we will look into this later.

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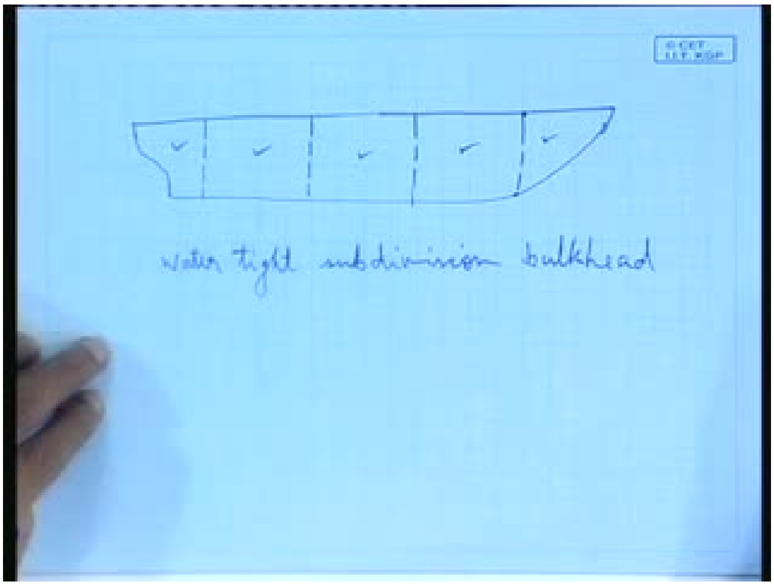

Bulkhead - one of the function is - they subdivide the ship in different compartments.

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Stations are imaginary locations that is needed to facilitate for the drawing purpose, they are imaginary locations there - you are sub dividing the vessel in ten equal stations, twenty equal stations. But bulkheads are physical locations of plated structure, they are plates - stiffened plates; these dotted lines are nothing but stiffened plates, they are the plated structure. You can talk about bulkhead little more - this simple profile of a vessel and those vertical lines which I showed you in the deck plan.

Once again I am redrawing them here, so this is nothing, but I have divided ship in five distinct compartments; these bulkheads are continuous, right from the bottom shell to the main deck, whole, all along in the gird of the vessel, water tight, then these are referred to as water tight subdivision bulkheads; these are referred to as water tight subdivision bulkheads. That means, each, the inter ship is being divided in five independent water tight compartments.

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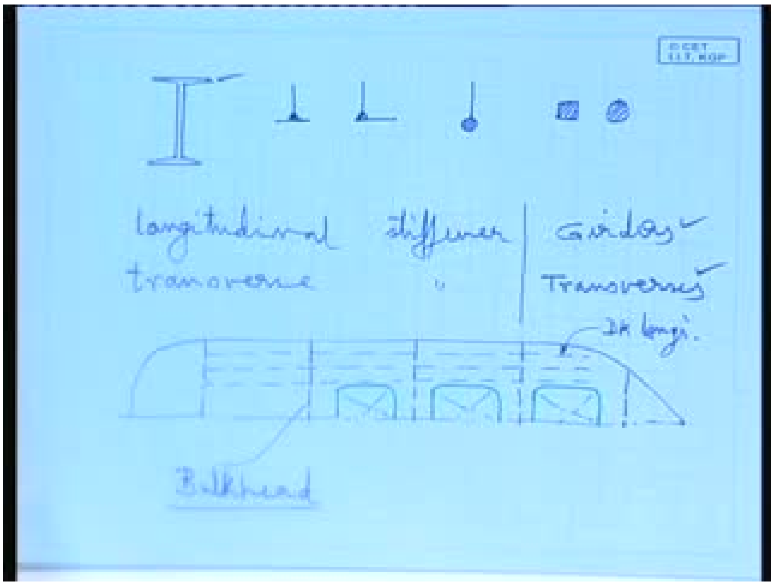

So, again coming back to that; these dotted lines in the deck plane, I can see, like this there is a continuous plate. Now, let us assume - the deck is longitudinal stiffened, that means, it has those stiffening members - it would be either an angle section or a bulb section; generally, this stiffeners will be either angle or bulb, not generally flat bars. Can you tell me why?

These stiffeners which I am putting in the deck, I am saying it will be generally bulb section or angle section - more strength is needed for the deck, you need most stiffness because the deck will be subjected to maximum stress, because it is farthest away from the global neutral axis; so you need more strength. To provide more strength or more stiffness, you need some stiffening arrangement or some kind of stiffener which will provide you higher section modulus.

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Why not t section? That will come later when you will see the actual cross-section of a vessel, when you will see with what kind of arrangements of these because as I said these are the basic building blocks; I use them to my requirement so you will see why not t, see that.

So, these are then longitudinal stiffener and since they are used in deck, we call them as deck longitudinal; so, I give a name to this stiffing members - I call them deck longitudinal. When I call, I refer to a stiffener by deck longitudinal, I know that is a stiffener I am talking about, which is connected in the deck. Similarly, now let us see what I have drawn here, what it could be? They are the hatch openings; this is the hatch opening - that means, the deck is cut here. I have drawn few hatch openings, what about this? There is an engine room, so I have not drawn heads opening here, you will have to have some compartment which is dedicated for the machineries.

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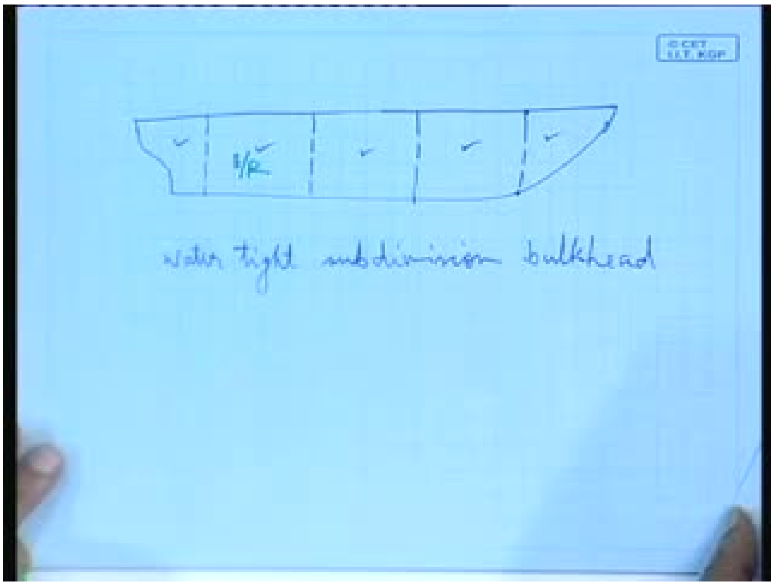

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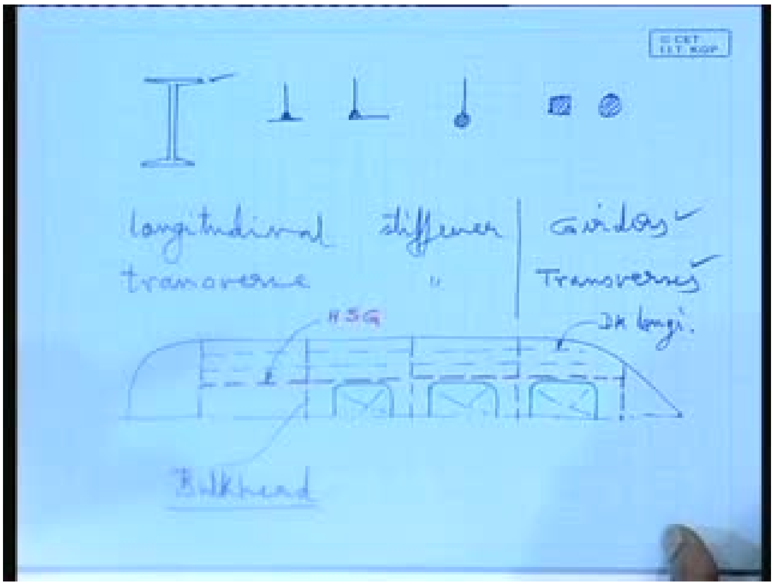

So, generally it is the after most, after most is this compartment obviously, but there we are not going because there we do not have much space. There is the section where it is something like this - this is the up peak. Here, generally, we have the engine room and these are the holds - cargo holds; so, I have drawn three-hatch opening. Now, think of this particular deck longitudinal, which I am just again over writing with this red color.

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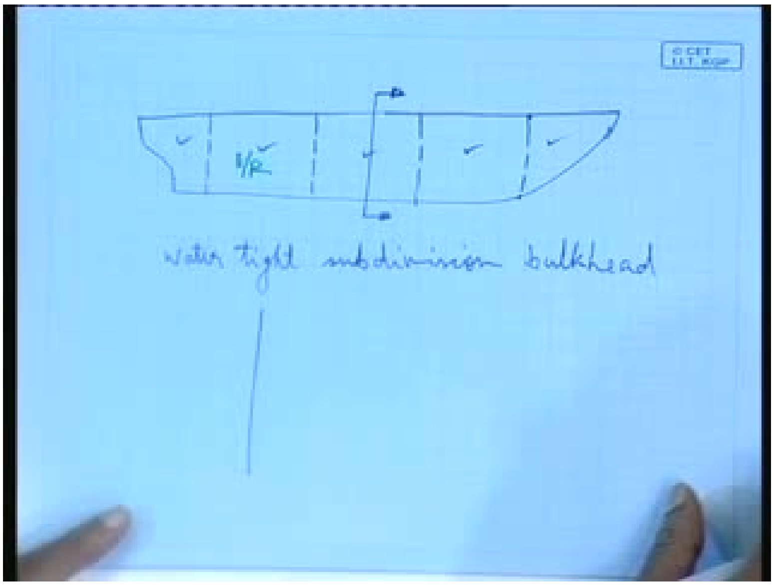

Why? It must have something in special, what is that specialty? Let me continue with this in the engine room also; is there any specialty of this? Specialty, yes - that it is just at the end of the hatch opening, so it derives a special name, that is, instead of saying - end of the hatch opening, this is, at the side of the hatch opening, that will be a better way. Because I give a name - hatch side girder; hatch side girder. Since that longitudinal is right at the side of the hatch opening, so I have given a special name - hatch side girder and mind you, I am not saying - hatch side longitudinal, I am saying - hatch side girder; that automatically implies - its scantlings are higher.

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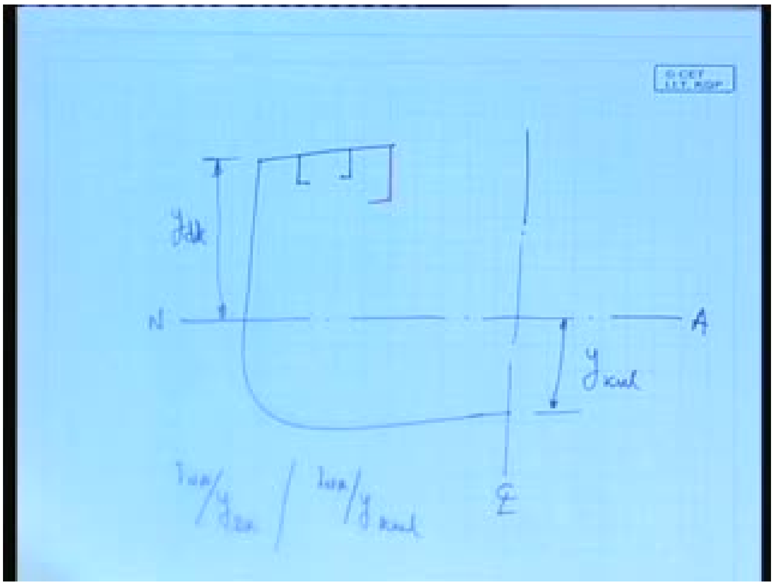

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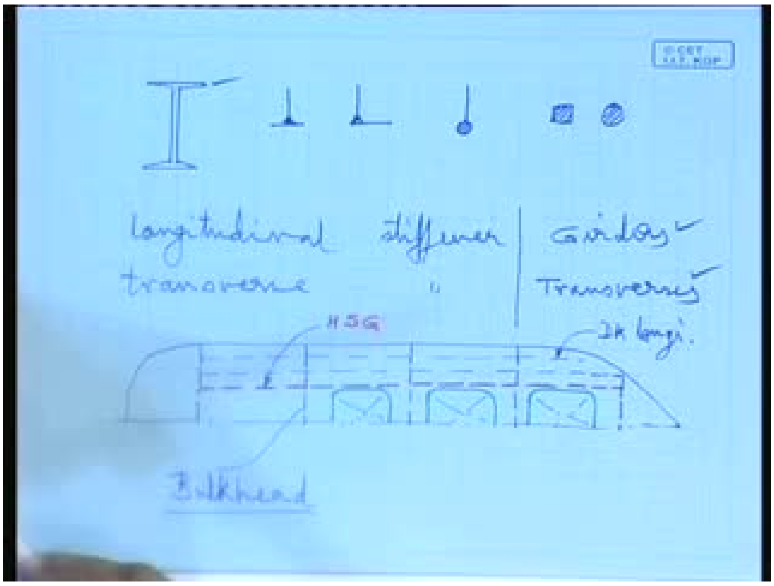

If we just take a look, suppose I take a section here, which is referred to as mid ship section. Let us draw this little bigger, this center line, I have the deck plating, this is hatch opening, so there we have drawn one two longitudinals and the red one, so just to match that. Let us assume, the longitudinals are unequal angles and the red one like this; so, these are my deck longitudinals and this is the hatch side girder - it is of greater length, greater scantling.

Why suddenly this is greater compared to these? What should be the scantling of these, scantling of the deck? What is the scantling of deck means, what thickness of the deck plating?

Side shell - here also we will have to have some stiffening arrangement, we will come to that later. So, all that we will do, all this layout of this stiffening arrangement, the stiffeners, etcetera, to achieve what? To achieve the section modulus - certain required section modulus at deck as well as at keel; this y deck and y keel is nothing but this is my y keel. (Refer Slide Time: 54:05)

These drawings are not very good, but you can understand. This y deck, so section modulus about the neutral axis divided by this keel, this distance or this distance will give you either of this section modulus. There is a requirement of how much this modulus should be, based on what should be the permissible stress on the deck and the keel, based on that.

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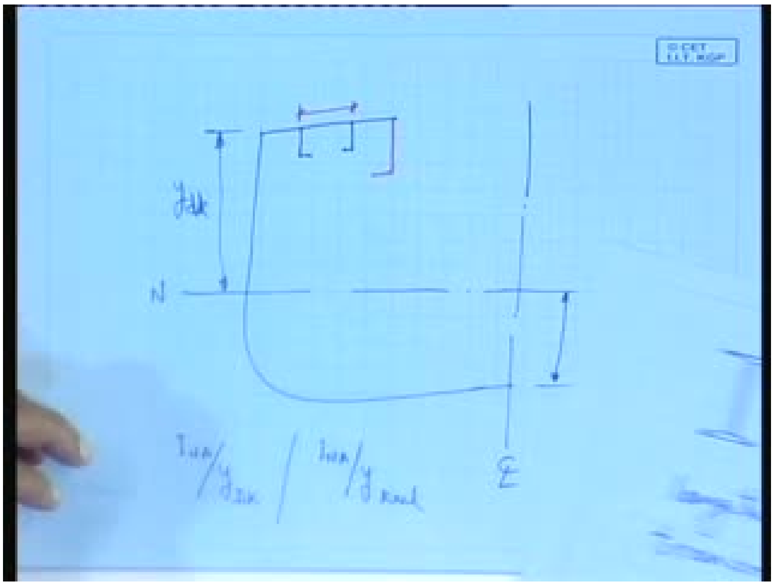

We will come to this, why this is certainly bigger, but let us now only see about the different types of stiffeners - deck longitudinal, hatch side girder. Now, you see if I have just a scheme of like this, in this fashion, then do not you think that it becomes quite nice, but it does not show much main bars/members which will provide transverse strength also. It is showing a good longitudinal strength because I have longitudinal members/main bars, mind you, here we have drawn only three longitudinal members/main bars. It is never like that, it will be several depending on the dimension; there is a fixed spacing, fixed means - you will decide on the spacing how much, so on that spacing it will be put; here we are only schematically showing.

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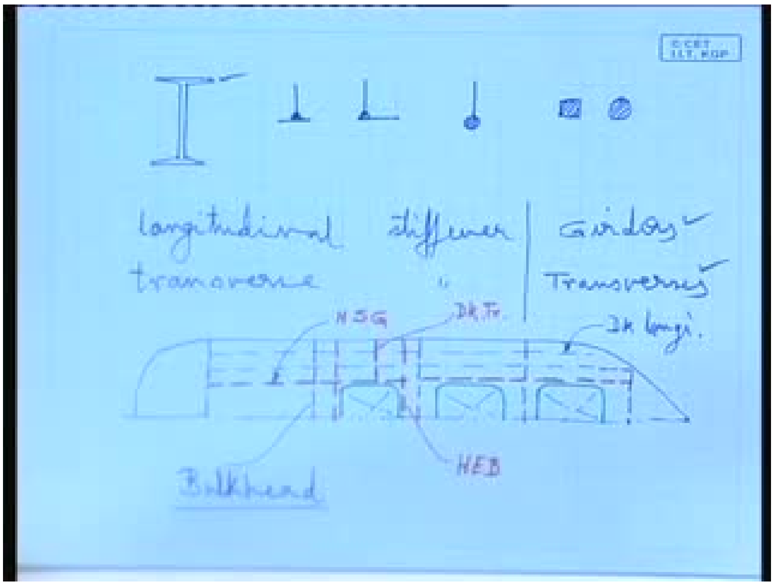

To provide for transverse strength, you will have to have transverse members/main bars also; suppose let us put transverse members/main bars like this. So, more or less in this fashion, transverse members/main bars will be repeated; all the transverse members/main bars I have drawn in red, by red I am signifying a greater scantling.

So what we have drawn? This extreme to red transverses, these two lines which represent transverse. Because they are in the transverse plane, they are at the hatch ends - so you call them hatch end beam; hatch end beam. The middle one, somewhere in middle, it is a transverse members/main bars and that will be in the deck, so deck transverse; it is referred to as deck transverse.

What is the difference between this transverse in this particular case and the longitudinals? It is - the longitudinals are much closely spaced whereas the transfers are very widely spaced. This is a longitudinal framing system; this type of arrangement is an arrangement based on longitudinal framing system. So, if my deck is stiffened in this fashion, we will say that the deck is stiffened longitudinally or longitudinal framing system has been adopted for stiffening the deck; so primary members are the longitudinals and the supporting members are the transverses.

So, we will see what is the specific function of this hatch side girder or the deck longitudinal or the hatch end beams or deck transverses? On what basis you look at the deck transverse? As far as hatch end beam and hatch side girder is concerned, it is fixed because I know the dimension of my hatch opening, that is dictated by some other requirement; little bit we have talked about - in container ship we have very wide opening, in bulk carrier you will have a narrower opening, and so on and so forth.

So, that will dictate the location of hatch side and girder and hatch end beams and the location of deck transfers, etcetera. How - we will see in the next class.